DRAFT GUIDE

"PROCEDURAL GUIDE FOR REVIEW OF THE AASHTO CONTROLLING DESIGN CRITERIA ON EXISTING ADOT ROADWAYS"

ARIZONA DEPARTMENT OF TRANSPORTATION

PLANNING & ENGINEERING GROUP

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INTRODUCTION

The "Procedural Guide for Review of the AASHTO Controlling Design Criteria on Existing ADOT Roadways" ("Procedural Guide") was developed as a direct result of the FHWA requirement that federally funded projects conform to the design parameters of the 1990 AASHTO "Policy on Geometric Design of Highways and Streets" or formal design exception must be approved.

A review of AASHTO Controlling Design Criteria became necessary when the Federal definition of "construction" was expanded to include "resurfacing, restoration, and rehabilitation" (3R) by the Federal-aid Highway Act of 1976. Before that time, the Federal-aid Highway Program was almost totally focused on new construction and/or total reconstruction, and virtually all projects complied fully with AASHTO design criteria -- exceptions were rare. With the change, the Federal-aid Highway Program became involved in projects aimed at preserving and prolonging the service life of existing highways, many of which did not meet current AASHTO criteria.

Implementation of this change prompted stiff criticism and opposition by highway safety advocacy groups, who feared that significant portions of the Federal-aid highway funds would be expended on 3R projects which resurfaced existing highways, with little or no regard for existing safety hazards or significant deviations from AASHTO criteria. Attempts by both AASHTO and FHWA to adopt specific criteria more appropriate to the 3R-type projects met even stiffer criticism and opposition by the safety advocacy groups, as well as considerable controversy within AASHTO, its member State highway agencies and FHWA.

After extensive study and discussion, FHWA adopted a regulation which allowed States the option to either (1) develop and submit special criteria for 3R projects to FHWA for approval, or (2) continue to apply full AASHTO criteria to 3R projects and request exceptions for any deviations left in place after completion of the 3R project. In a direct response to this regulatory action and at the prompting of the highway safety advocacy groups, Congress, in 1982, further modified the Federal definition of construction by adding the phrase "enhance highway safety". This modification effectively required all Federally-funded 3R projects to include at least some form of safety improvement, and forcefully demonstrated the continuing concern that existing conditions not meeting current standards, be perpetuated without adequate evaluation and justification.

Arizona elected to follow the second option -- to continue using full AASHTO criteria for 3R projects, and request design exceptions for appropriate, justified deviations. To facilitate and simplify the identification of these deviations, FHWA established a national policy requirement for review of 12 (originally 13) controlling criteria.

In addition to complying with the Federal Regulation and Policy, as noted above, the process of reviewing the controlling AASHTO criteria has the added benefit of identifying and analyzing the number, extent and anticipated consequences of retaining or perpetuating conditions not meeting current standards. Among other things, this effort is necessary to offset the continuing criticism by highway safety advocacy groups that highway agencies tend to resurface existing highways without regard for the existing conditions.

The "Procedural Guide" is the method by which ADOT will identify various project design features to determine whether or not they meet the 1990 AASHTO Green Book guidelines. Subsequent to this determination, decisions will then be made on whether or not it is in the best interests of the Department and motoring public to upgrade features which do not meet AASHTO Guidelines.

In the case of pavement preservation and 3R/4R projects, the decisions will become extremely difficult since the AASHTO Green Book is directed toward new designs, and in most cases, the 3R/4R type projects apply to older sections of highways which were not designed or constructed to meet current AASHTO guidelines. Achieving AASHTO shoulder widths and vertical alignment in many cases would require reconstruction of entire sections.

In considering the "Procedural Guide" applied to ADOT's projects, it does not appear to be practical to differentiate based upon the type of funding for a project, even though the "Procedural Guide" was developed in response to federal requirements. The intended scope of work for a project or concept for a project should determine if the "Procedural Guide" will apply.

The following section will discuss the types of projects to which the "Procedural Guide" will be applied.

PROJECT APPLICATION

I. Projects Utilizing the "Procedural Guide"

The "Procedural Guide" will apply to the following general types of projects when developing the project requirements:

A. New Construction - Constructing a new roadway adjacent to an existing road to obtain a divided roadway.

B. Reconstruction of Existing Roadway

1.Realignment

2.Widening

3.Resurfacing - overlays thicker than one inch, mill and replace.

In applying the Procedural Guide to new construction where a new alignment is being proposed, the Controlling Criteria will be applied to the existing alignment and not the new alignment when the existing is to remain. If reconstructing an existing roadway, the project proposes only partial new alignment, the Controlling Criteria will be applied to the partial existing alignment not being reconstructed.

An AASHTO Controlling Design Criteria report may be prepared on an existing roadway, which is being replaced by a new roadway or totally reconstructed in order to better define the purpose and need for the new or reconstructed roadway.

Note: The review of the AASHTO Controlling Design Criteria will <u>not</u> be utilized on existing interchanges and/or Grade Separations for resurfacing type projects. However, if the scope is significant, such as pavement replacement, extensive widening or reconfiguration, a review is necessary. Otherwise, the accident patterns or operational problems identified by Traffic, District or the field review group will be utilized to determine the need to review the criteria for the interchanges.

II. Projects Not Utilizing the "Procedural Guide"

The following types of projects will not generally apply to the "Procedural Guide". These projects are normally singular in scope, are maintenance type, or are spot improvement projects:

A. Seal Coats - ACFC's, chip seals, and overlays one inch or less in thickness.

B. Guardrail

C. Structure Extensions - pipe and box culvert

D. Signing and / or Striping, Channelization

E. Signalization

F. Fencing, Cattle Guards

G. Railroad Crossings

H. State Parks

I. Rest Areas

J. Landscaping and Irrigation

K. Bridge Maintenance, Bridge Replacement *

L. Drainage Improvement - changes in profile require a review of the vertical alignment

M. Grinding and Joint Repair - FHWA may require written exceptions depending upon degree of involvement in other work items.

N. Wye Intersection Improvement - *

O. Curve Realignment - *

P. Safety (Old HES funded projects)**

*The design criteria directly involved in these types of projects should be reviewed; i.e. - Roadway Width, Horizontal and Vertical curvature, SD_S, Superelevation, Intersection Sight Distance.

**We must remember that these types of projects are to upgrade (and maybe even not to current standards) certain features that have been attributed to causing accidents. These projects also have a CLOSE Report approved by FHWA. It is understood that when FHWA approves the CLOSE Report, they also approve all design exceptions too.

PROCEDURES

A determination of the need to apply the "Procedural Guide" to any project must be accomplished at the earliest possible time during the Highway Development Process.

Using the Project Application section previously outlined, Roadway Predesign Section will determine which projects will utilize the "Procedural Guide". On projects where it may be unclear as to whether the "Procedural Guide" should be utilized, the Roadway Group Manager has the authority to make this determination.

Roadway Predesign Sections will be preparing Design Concept Reports or Combined Location and Design Concept Reports for projects involving New Construction or Reconstruction of Existing Roadways. These Concept Reports will address whether or not the AASHTO Controlling Design Criteria has been met and will include recommendations in the report.

Roadway Predesign Sections will also be coordinating preparation of Project Assessment Reports on other projects for the purpose of describing the design features of the project and formulating project costs. In the case of Resurfacing projects which require that the "Procedural Guide" be utilized, the Project Assessment Report will be expanded to include analysis and recommendations in applying the AASHTO Controlling Design Criteria.

The AASHTO Controlling Design Criteria Report will provide the evaluations and recommendations for incorporating design features which may not meet the guidelines established in the 1990 AASHTO Green Book as described in the "Procedural Guide". This report will be utilized in obtaining formal design exceptions on federal-aid and State funded projects, and will also serve as file documentation for any projects where the "Procedural Guide" is utilized.

OVERVIEW

The purpose of this "Guide" is to provide a systematic approach to the review of existing roadways prior to implementing improvements to those roadways. Existing design related data can be gathered through various sources and then compared to the "controlling" design criteria designated by "A Policy on Geometric Design of Highways and Streets," 1990 edition, commonly referred to as the "AASHTO Green Book".

With this procedure, differences between existing and the desired AASHTO features can be determined. The differences can then be evaluated through analysis so that recommendations can be made as to whether or not additional work should be undertaken.

It is not the intent of this guide to describe a complete evaluation process. The overall evaluation will require good engineering judgement. The degree and depth of the evaluation will be dependent upon the individual project and the judgement of the engineer. Factors such as economics, anticipated growth, accident history, program schedules, and time and manpower requirements all may have some bearing prior to final determination.

This guide was prepared with the pavement preservation program as the primary area of the application but can be utilized with any planned projects on existing roadways as desired.

LANE WIDTHS AND SHOULDER WIDTHS

Lane width and shoulder width on an existing roadway can be determined by researching the as-built plans. The Milepost Log and State Highway System Log are also useful tools for ready reference. There are, however, discrepancies in these references which many times can best be resolved by actual field measurement. During the initial or predesign field reviews, lane and shoulder widths should be observed and verified as necessary to determine how the existing widths compare with guidelines in the 1990 AASHTO Green Book.

The AASHTO references are summarized in the following table for the various functional classifications of roadways. To determine the functional classification of the roadway which is being considered, utilize the State Highway System map with the color coded classification legend prepared by Transportation Planning. The State Highway System Log is useful in identifying urban boundaries.

Upon determination as to whether lane and shoulder widths meet the minimum AASHTO criteria, evaluation will be required to determine what, if any, modifications should be recommended for implementation.

Functional Classification	1990 Green Book Ref.
A. Rural Local Roads	p. 426
B. Rural Collector Roads	pp. 473-464
C. 1. Rural Arterial Highways (2-lane)	p. 498
2. Divided Rural Arterial	pp. 508-509
3. Undivided Rural Arterial	pp. 506-507
D. Rural Freeways*	p. 583

E.	Local Urban Streets	pp. 436-437
F.	Urban Collector Streets	pp. 482-483
G.	Urban Arterial Streets	pp. 526-527
H.	Urban Freeways*	p. 583

* Note:For the Interstate System, see "A Policy on Design Standards-Interstate System," 1991.

VERTICAL ALIGNMENT AND STOPPING SIGHT DISTANCE

As-built plans are normally the best source of data available for evaluation of existing profile alignments. In some instances, hard copy maps or other survey information may be available in the absence of as-built plans.

Once the existing alignment has been determined, the 1990 AASHTO Green Book (pp. 283-293) can be utilized to determine the theoretical adequacy of the existing profile.

a) Utilize equation (3) or (4) (pp. 283) to calculate the existing sight distance for crest vertical curves; utilize equation (7) or (8) (p. 289) to calculate the existing sight (light beam distance) for sag vertical curves. The calculated sight distances should be compared to Table III-40 (p. 284) and / or Table III-32 (p. 293) the upper limit for the required stopping sight distance for design.

b) Utilize Figure III-41 (p. 285) input the length of the existing crest vertical curve and the algebraic difference of the existing grades to determine the existing speed (V_E).

c) Utilize Figure III-43 (p. 291) input the length of the existing sag vertical curve and the algebraic difference of the existing grades to determine the existing speed (V_E).

V_E will provide an indication of the theoretical design speed which the existing vertical curve will provide and can then be compared to the design speed desired for the given section of highway in making an evaluation of the need for any modification to the existing vertical alignment.

Roadway Predesign has a computer program which is designed to input existing vertical alignments and output design speeds, stopping sight distance on crest verticals and headlight distance for sag verticals.

An inventory of the existing posted and advisory speed limits for the section of highway should be obtained for the overall evaluation process. This information can be obtained during the site visit or from the HODS (Highway Optical Data System).

HORIZONTAL ALIGNMENT, SUPERELEVATION, AND STOPPING SIGHT DISTANCE

The existing horizontal alignment with corresponding curve data and superelevation can be obtained utilizing the as-built plans. While the degree of curvature shown on as-built plans is generally very reliable, the superelevation data cannot be relied upon because revisions to superelevation during construction have not been well documented in the past. Also, subsequent overlay projects and maintenance work may have changed the original superelevation.

Tables III-8 through III-11 (pp. 166-169) in the 1990 AASHTO Green Book can be utilized as the desired standards for curvature and superelevation for rural highways and high-speed urban streets. As in the case of vertical alignments, the posted and advisory speed limits throughout the alignment will provide information for helping to determine if modifications are needed.

Since as-built superelevation data may not be reliable, other means of reviewing superelevation are needed. It is not the intent to field survey each curve to determine actual values, however, the following actions should be performed during the initial field review:

a) Observe the comfort level of the existing curves as they are driven through at the posted speeds.
b) Arrange to discuss and review any particular problem areas with the maintenance foreman responsible for the area.

ADOT has adopted maximum rates for superelevations as follows:

a) Rural Highways (controlled and non-controlled access)

   Above elevation 6000 ft - 0.060 ft / ft

   Between elevation 4000 ft & 6000 ft - 0.080 ft / ft

   Below elevation 4000 ft - 0.100 ft / ft

b) Urban Highways

Controlled access - 0.060 ft / ft

Non-controlled access - 0.040 ft / ft

Roadway Predesign has a computer program which is designed to input existing horizontal curve data and output required curve data for a specific design speed.

Superelevation on low-speed urban streets (40 mph or less) is not required. Horizontal curves are frequently designed without superelevation, counteracting the centrifugal force solely with side friction. However, the minimum radius as per Table III-16 (p. 193) for a maximum superelevation rate of zero cannot be exceeded.

For a full discussion of design for low-speed urban streets see Chapter III of the 1990 AASHTO Green Book beginning on pages 186 - 187.

Stopping sight distance on horizontal curves is also an important feature which should be closely observed during the initial field review. During the drive through the project, features which would appear to restrict horizontal sight distance such as narrow cut ditches, trees, outcroppings, etc. should be observed. Figure III-26(B) (p. 223) of the 1990 AASHTO Green Book should be utilized to determine the desired sight distance. Measurements can be taken during the field visit to determine if restrictions do exist or additional data can be requested as needed.

DESIGN SPEED

The design speed is a function with respect to the terrain, adjacent land use, and the functional classification of the highway. (Terrain is discussed on page 226-227 of the 1990 AASHTO Green Book.)

The minimum design speeds recommended by the 1990 AASHTO Green Book are referenced in the following table for the various roadway classifications:**

Functional Classification	1990 Green Book Ref.
** Per ADOT Transportation Planning Map	
A. Local Rural Roads	p. 420
B. Rural Collector Roads	p. 469
C. Rural Arterial Highways	p. 494
D. Rural Freeways *	p. 581
E. Local Urban Streets	p. 434
F. Urban Collector Streets	p. 480
G. Urban Arterial Streets	p. 524
H. Urban Freeways *	p. 581

Once the minimum design speed has been determined, this recommended minimum should be utilized for determining the design speed for the segment of roadway being reviewed.

The effective design speed or theoretical design speed for any segment of an alignment can be determined by analysis utilizing the procedures outlined under the sections entitled Vertical Alignment and Stopping Sight Distance and Horizontal Alignment, Superelevation, and Stopping Sight Distance.

*Note: For Interstate System, see "A Policy on Design Standards - Interstate System," 1991.

GRADES

The mainline profile on a route can be determined by a review of the as-built plans. The HODS films also provide a reading of the percent of grade at each milepost photo location and may be useful in some instances. The review of the vertical alignment and stopping sight distance will provide some indication of grades which may need further evaluation. In general, AASHTO has established guidelines for suggested maximum grades for various roadway classifications as follows:

Functional Classification	1990 Green Book Ref.
Per ADOT Transportation Planning Map	
A. Local Rural Roads	p. 422
B. Rural Collector Roads	pp. 470,472
C. Rural Arterial Highways	p. 496
D. Rural Freeways *	pp. 584-585
E. Local Urban Streets	p. 435
F. Urban Collector Streets	pp. 480-481
G. Urban Arterial Streets	pp. 524-525
H. Urban Freeways *	pp. 584-585

*Note: For Interstate System, see "A Policy on Design Standards - Interstate System," 1991.

CROSS SLOPE

The primary consideration on cross slope is to provide adequate pavement drainage. This item should be addressed by visual observation during the site visit. Also, District representatives should be asked to provide any historical information in regard to problems with cross slope, ponding on the pavement, or irregular shape of the cross section.

In some instances, the existing pavement cross section may have become distorted due to several overlays and/or maintenance treatment. If this is the case, the new pavement design should consider alternatives such as additional removal, milling, or total reconstruction of the pavement section. This should be coordinated closely with Materials Section and should be included in their pavement evaluation process.

AASHTO has established guidelines for ranges of cross slopes for various roadway classifications as follows:

Functional Classification	1990 Green Book Ref.
A. Local Rural Roads	p. 423
B. Rural Collector Roads	pp. 471-472
C. Rural Arterial Highways	p. 508
D. Rural Freeways **	p. 583
E. Local Urban Streets	p. 435
F. Urban Collector Streets	p. 481
G. Urban Arterial Streets	pp. 525-526
H. Urban Freeways **	p. 583

**Note:For Interstate System, see "A Policy on Design Standards - Interstate System," 1991.

VERTICAL CLEARANCES

Underpass clearances at bridge structures should be verified through a review of the Bridge Inspection Maintenance Reports** which are available in ADOT Structures Section. Existing clearances can then be compared with the AASHTO recommended clearances.

Whenever a change in the existing profile grade on an existing route is being contemplated, the vertical clearances at existing structures should be reviewed to determine how the proposed changes in profile (overlay, mill, etc.) may affect the clearance.

The AASHTO recommended vertical clearances for the various classifications of roadways are as follows:

Functional Classification	1990 Green Book Ref.
A. Local Rural Roads	p. 428
B. Rural Collector Roads	p. 476
C. Rural Arterial Highways	p. 497
D. Rural Freeways *	pp. 585-586
E. Local Urban Streets	p. 443
F. Urban Collector Streets	p. 486
G. Urban Arterial Streets	p. 526
H. Urban Freeways *	pp. 585-586

*Note: For Interstate System, see "A Policy on Design Standards - Interstate System," 1991.

**Note: Always compare the date on the bridge maintenance record to the date on the as-builts to assure that the roadway was not overlaid after the bridge inspection.

BRIDGE WIDTHS

Information on existing State-owned bridges located within the project limits is listed in the Arizona State Highway System Bridge Record published by the Structures Section. BRIDGE WIDTH is defined as the minimum clear roadway width on the bridge as listed under the column heading "Curb to Curb" of the Bridge Record. This information can be obtained from the Bridge Management Engineer by submitting a Bridge Evaluation Request Form.

For all existing bridges contained within the project limits the Bridge Width shall be compared with the AASHTO guidelines as contained in the 1990 Green Book. The AASHTO Bridge Width criteria is referenced below for the various Functional Classifications of roadways:

Functional Classification	1990 Green Book Ref.
A. Local Rural Roads	pp. 426-428
B. Rural Collector Roads	pp. 474-476
C. Rural Arterial Highways	p. 497
D. Rural Freeways *	pp. 584-585
E. Local Urban Streets	pp. 427,443
F. Urban Collector Streets	pp. 475,485-486
G. Urban Arterial Streets	p. 534
H. Urban Freeways *	pp. 584-585

*Note: For Interstate System, see "A Policy on Design Standards - Interstate System," 1991.

BRIDGE WIDTH OVERVIEW:

The Structures Section must consider many factors when making a determination that an existing bridge width that is not to current standards is to be reconstructed or replaced. The Bridge Evaluation Request Form will show if the structure is to be widened.

STRUCTURAL CAPACITY

It is ADOT policy to design all new and reconstructed bridges for HS 20 design loading regardless of the functional classification of the roadway. All bridges on the project will be evaluated by the Bridge Management Engineer when a Bridge Evaluation Request Form is submitted.

The AASHTO Structural Capacity criteria is referenced below for the various Functional Classifications of roadways:

Functional Classification	1990 Green Book Ref.
A. Local Rural Roads	pp. 426-428
B. Rural Collector Roads	pp. 474-476
C. Rural Arterial Highways	p. 497
D. Rural Freeways *	pp. 584-586
E. Local Urban Streets	Same as Rural
F. Urban Collector Streets	Same as Rural
G. Urban Arterial Streets	Same as Rural
H. Urban Freeways *	Same as Rural

*Note: For Interstate System, see "A Policy on Design Standards - Interstate System," 1991.

BRIDGE BARRIER

The bridge barrier type for State-owned bridges is listed in the Arizona State Highway System Bridge Record and for all other bridges is listed in the Arizona City Streets and County Roads Bridge Record. This information can be obtained from the Bridge Management Engineer by submitting a Bridge Evaluation Request Form.

Evaluation of the bridge barrier replacement is the responsibility of the Bridge Management Engineer and will be shown on the Bridge Evaluation Request Form.

For information regarding bridge barrier and off-bridge transition features such as barrier curbs, walkways and roadside barriers refer to the 1990 Green Book Sections on Curbs, p. 344, Sidewalks, pp. 349-351; and Bridge Railings, pp. 366-367.

OTHER CONSIDERATIONS:

A. DESIGN TRAFFIC VOLUMES

Current/Construction* year and design year traffic volumes are needed for utilization of the AASHTO tables for Lane and Shoulder Widths, Design Speed, Bridge Width and Structural Capacity. The design year selected will normally range from current or construction year to 20 years depending upon the type of project or improvement planned. A 10 year design is normally utilized for pavement preservation projects.

Current/Construction year and projected design year traffic volumes along with traffic factors (peak hour factor, % trucks, directional distribution) can be obtained by request from Transportation Planning.

The AASHTO guidelines on Design Traffic Volumes for the various roadway classifications are:

Functional Classification	1990 Green Book Ref.
A. Local Rural Roads	p. 420
B. Rural Collector Roads	pp. 468-469
C. Rural Arterial Highways	pp. 494-495
D. Rural Freeways	p. 582
E. Local Urban Streets	p. 434
F. Urban Collector Streets	p. 480
G. Urban Arterial Streets	p. 524
H. Urban Freeways	p. 582

*Note:Use construction year if construction year is known. Use current year if construction year is unknown. Current being the year shown in the problem statement as proposed contruction year or the third year of the next 5 Year Program.

B. INTERSECTION SIGHT DISTANCE

The at-grade intersections of the through facility with public roads should be observed for adequacy of sight distance during the initial field review for the project. If there appears to be a potential problem with sight distance, additional data may need to be gathered. Consideration should be given to modifications to obstructions which occur within the sight triangle. The location of the intersection on the vertical alignment is also an important factor.

A full discussion of intersection sight distance is contained in Chapter IX of the AASHTO Green Book beginning on page 739. In addition, Traffic Engineering Section procedural guide PGP-2C-0-0, September 1986 may be used to evaluate sight distance at intersections on the state highway system.

1. RAMPS

a) Lane widths and shoulder widths:

Ramp pavement widths of an existing TI can be determined by researching the as-built plans. During the predesign field reviews, pavement widths should be observed and verified as necessary to determine how the existing widths compare with the guidelines in the 1990 AASHTO Green Book.

Design widths of ramp pavements for various conditions are discussed on Page 975 and width is given in Table X-3, Page 976. (Also, see FHWA Memo of 09/28/88 for additional instructions.) (Maximum width is Case I Traffic Condition C plus 10ft.)

Case II with design traffic condition C are to be utilized for all ramps except if the vpd volume is under 100 vpd, then Case II, condition B may be utilized for single lane ramp.

Upon determination as to whether pavement width meets the minimum AASHTO criteria, evaluation will be required to determine what, if any, modification should be recommended for implementation.

b) Vertical alignment and stopping sight distance:

Vertical data of an existing ramp are normally available by researching the as-builts. Once the existing alignment has been determined, the data can be input into our Vertical Curve Analysis computer program which is designed to output stopping sight distance of the existing and required and the theoretical design speed of the existing vertical curve.

The 1990 AASHTO Green Book can also be utilized to determine the theoretical adequacy of the existing profile. Equation (3) or (4) (pp. 283) and equation (7) or (8) (p. 289) can be used to calculate the existing sight distance. Figure III-41 (p. 285) and figure III-43 (p. 291) can be used to determine the theoretical design speed which the existing vertical will provide.

c) Horizontal alignment, superelevation and stopping sight distance

The existing horizontal alignment with corresponding curve data and superelevation can be obtained from the as-built plans. While the degree of curvature shown on as-built plans is generally very reliable, the superelevation data cannot be relied upon because revisions to superelevation during construction have not been well documented in the past. Also, subsequent overlay projects and maintenance work may have changed the original superelevation.

The 1990 AASHTO Green Book Tables III-8 through III-11 (pp. 166-169) can be used to determine the adequacy for curvature and superelevation, or the data can be input into our Horizontal Curve Analysis computer program which is designed to output the allowable maximum degree of curvature and minimum superelevation if the ramp design speed is greater than 40 mph. If the ramp design speed is equal to or less than 40 mph, use Table IX-12 (page 777 of the 1990 Green Book) for superelevation rate.

Since as-built superelevation data may not be reliable, or available, other means of reviewing superelevation are needed. It is not the intent to field survey each curve to determine actual values, however, the following action should be performed during the initial field review:

1) Observe the comfort level of the existing curves as they are driven through at the posted speeds.
2) Arrange to discuss and review any particular problem areas with the maintenance foreman responsible for the area.

Stopping sight distance on horizontal curves is also an important feature which should be closely observed on the initial field review. During the drive through the project, features which would appear to restrict horizontal sight distance such as narrow cut ditches, trees, out croppings, etc. should be observed. Figure III-26(B) (p. 223) of the 1990 AASHTO Green Book should be used to determine the desired sight distance. Measurements can be taken during the field review to determine if restrictions do exist or additional data can be requested as needed.

d) Design Speed

The minimum design speed recommended by the 1990 AASHTO Green Book is referenced in Table X-1 on Page 960. The minimum design speed for freeways and expressway diagonal exit ramps is 50 mph, this is usually for the ramp proper. This speed does not pertain to the ramp terminals which should be properly transitioned and provided with speed-change facilities adequate for the highway speed involved.

Loop design speed preferably should not be less than 25 mph (150 ft radius).

For direct and semi-direct connection see page 961 of the 1990 AASHTO Green Book.

e) Grades

Profile grades on a ramp can be determined by a review of the as-built plans. In general, AASHTO has established guidelines for suggested maximum grades on Pages 963 to 965 of the 1990 Green Book. The ascending and descending grades should be limited to 3-5%. However, with proper ramp terminal facilities, short upgrades of 8% permit safe operation without unduly slowing down passenger cars. On one-way down ramps, gradients up to 8% do not cause hazard due to excessive acceleration.

f) Cross Slope

The cross slope on portions of ramps on tangent normally are sloped one-way at a practical rate that may range from 1.5 to 2.0 percent for high-type pavements.

g) Vertical Clearances

Underpass clearances at bridge structures should be verified through review of the Bridge Inspection Maintenance Reports which are available in ADOT Structures Section. Existing clearances can then be compared with the AASHTO recommended clearance.

Interstate and freeway route should have a minimum vertical clearance of 16 feet. All other roadways should have a minimum clearance of 14 feet.

h) Bridge Widths

Information on existing State-owned bridges is listed in the Arizona State Highway System Bridge Record published by the Structure Section. BRIDGE WIDTH is defined as the minimum clear roadway width on the bridge as listed under the column heading "Curb-to-Curb" of the Bridge Record. Information obtained from the Bridge Record should be verified with the Structure Section Bridge Maintenance Services. Details for the bridge deck and the attendant bridge rail, curbs and sidewalk may be obtained from the bridge inspection files and from available as-built plans.

Clear width on bridges should preferably be as wide as the approach roadway. On long bridges, some compromise from the desirable may be necessary.

i) Structural Capacity

The AASHTO Structural Capacity criteria is the responsibility of the Bridge Management Engineer.

j) Bridge Barrier

The evaluation of the bridge rail is the responsibility of the Bridge Management Engineer. Rail will be evaluated both for structural and geometric criteria.

k) Other Considerations

A. Traffic Volumes

The year the project is going to be constructed and design year traffic volumes are needed for the utilization of the AASHTO tables for ramp width. The design year selected will normally be 20 years. A ten-year design is normally utilized for pavement preservation projects.

2. CROSSROAD

Determine the functional classification of the crossroad utilizing either the map prepared by Transportation Planning (Functional Classification for the Arizona State Highway System) if the crossroad is a state route, or the section containing the definitions and characteristics of highway facilities (pages 8-17) of the 1990 Green Book.

Once the classification has been established, then utilize the "Guide" for means to identify and evaluate the AASHTO recommended design criteria.

Note: Except in very unusual circumstances, the crossroad will always have the same terrain classification as the mainline.

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